North Park Lake Aquatic Ecosystem Restoration Project

by James A. Kosky, P.E. [1]

Introduction.

North Park Lake is located in Allegheny County's North Park about 10 miles north of the city of Pittsburgh, Pennsylvania. In 1935, Pine Creek Dam was constructed to impound 568 acre-feet of water to form North Park Lake. Two forks of Pine Creek referred to as North and South Fork Pine Creek form the lake. North Park and Pine Creek Dam are owned and operated by Allegheny County. The park and lake provides recreation including fishing, boating, picnic groves, baseball fields, tennis courts, walking trails, a swimming pool, golf course and much more for people to enjoy. It is heavily used in the summer time with over 240,000 people renting picnic shelters and buildings. Millions of people enjoy the lake and park each year. Some of the winter activities include ice-skating and ice fishing. Figure 1 is a location map of the general area with respect to the U.S. Army Corps of Engineers Pittsburgh District Plan of Development map. Figure 2 is a photograph of the lake looking upstream standing on top of the dam.

Pine Creek Dam is 33 feet high, approximately 1,130 feet long, has a 60-foot wide spillway crest and is located on Pine Creek. It has an uncontrolled spillway set at 10 feet below the top of the dam. The outlet works consist of an intake tower with a manually controlled 5 foot by 5 foot sluice gate which has not been operated recently. Table 1 shows pertinent information about North Park Lake and Pine Creek Dam and Figure 3 is a photograph of the dam.

Background.

Originally in 1935, North Park Lake had a surface area of 75 acres and drainage area of 25 square miles. The land was mainly farmland with rolling hills used for agricultural purposes and woodlands. Over the years, especially during the 1970's to the present time, urbanization has occurred including new housing developments, malls and industrial areas which were built upstream of the lake. Due to this increase in urbanization and continuous stream bank erosion, the lake's capacity has been reduced by almost 50 percent. Sediment has accumulated over the entire lake creating major problems with the open water habitat. At the dam, the depth of the lake has been reduced by about 14 feet with the sediment piling up on the intake control structure and burying the outlet control gate. Fish and other open water habitat have suffered from the sedimentation accumulation problem prompting this ecosystem restoration project. The main goal of this project is to enhance and restore the aquatic ecosystem of North Park Lake. The project consists of dredging the lake,

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construction of a wetland protection structure and fringe wetlands creation. It is currently in the Detailed Project Report (DPR) phase. Allegheny County, who is the sponsor, will work with the U.S. Army Corps of Engineers and many others as a team to help restore the lake.

Sedimentation Analysis.

The Pittsburgh District used the sedimentation experts from the Engineering Research and Development Center (ERDC) in Vicksburg, Mississippi under the headquarters of the Waterways Experimental Station (WES) for the sedimentation analysis. The first step in the sedimentation analysis was to investigate the history of the lake. Copies of the original engineering drawings for the construction of the dam were found in the 1979 Dam Safety Report on Pine Creek Dam (USACE–Baltimore District, 1979). Included in the report, were the original surface area and capacity values calculated on the drawings. Original topography of the land before the dam was built was also found. New one-foot topography and soundings were surveyed for the lake in 2001. New lake surface area and capacity values were calculated and compared to the original data. The lake's surface area and capacity lost due to the sediment accumulation were computed. The average annual sedimentation rate was determined to be 5,200 tons per year. ERDC's experts recommend using actual data when determining sedimentation rates as the best alternative rather than theoretical equations.

To further analyze the sedimentation problem, Corps of Engineers EM 1110-2-4000 "Sedimentation Investigations of Rivers and Reservoirs" was followed to determine sedimentation rates (USACE–ERDC, 1995). Sedimentation rates are very important since they will determine future operation and maintenance needs plus provide a frequency of accumulation estimate. The methodology followed included determining a flow duration using the ERDC's publication "Effective Discharge Calculation – A Practical Guide" (USACE–ERDC, 2000). A flow duration curve at a nearby stream gaging station was developed and correlated at each fork that enters the lake. Multiple flow measurements were made at two sites on each fork entering the lake. Sediment samples were taken and processed at a lab to determine sediment characteristics. This data was used to determine a sediment rating curve. The information was all put together and following the EM a theoretical sedimentation rate of 1,100 tons per year was computed. This rate was compared to the actual data and it was determined that using the actual data gave better results.

Using the above information, it was determined that approximately 400,000 cubic yards of sediment has to be removed from the lake to return it back to the original contours and restore the lake's ecosystem. Trap efficiency of the lake was determined following the EM 1110-2-4000 Appendix F using the Brown, Brune, Churchill and Hazen methods. The trap efficiency was used to estimate the percentage of sediment trapped by Pine Creek Dam. Table 2 shows sedimentation analysis information. Alternatives, including hydraulic and mechanical dredging,

were discussed with the ERDC's dredging experts and the project team. Final dredge method alternatives have not been formulated at this time.

Hydrology and Hydraulics.

For use in the sedimentation analysis and other features investigated in the restoration of the lake, a hydrologic and hydraulic study was needed. For the hydrologic portion of the study, various methods were used to determine a range of frequency flows. The Soil Conservation Service TR-55 (NRCS, 1980) and Snyder's Unit Hydrograph methods using HEC-HMS rainfall runoff model (USACE-HEC, 2000), Pittsburgh District Multiple Regression Formulas (USACE–Pittsburgh District, 1977), U.S. Geological Survey regression methods for Pennsylvania (USGS, 2000) and the Federal Highway Administration (FHA, 1980) methods were all used to determine a range of flow frequencies. Comparison of all the various methods was performed with the Pittsburgh District Multiple Regression method being adopted. This method agreed with past studies and regional flow-drainage curves.

For the hydraulic portion of the study, a HEC-RAS model was set up to investigate a proposed wetland protection structure (USACE-HEC, 2001). The structure will be developed as a spur dike to keep the upper wetlands on the South Fork from sliding into the lake. This structure will be made out of rock and will provide areas for fish and other open water habitat. Fringe wetland creation was also investigated around portions of the perimeter of the lake to create additional wetlands and provide a buffer zone (USACE-ERDC, 2000; USDA, 1996 and NRCS, 1997). Other areas in the lake are being investigated to help enhance the area such as not mowing in the riparian areas to relieve some of the geese overpopulation around the lake.

Placement Areas.

Potential placement areas for the 400,000 cubic yards of material are still being investigated at this time. Plans are to transport the material as close to the lake as possible to reduce delivery costs. It was estimated that approximately 20-25 acres of land would be needed to handle placement of the material. Some potential placement areas are located within the Allegheny County park boundary and also on private property near the park.

Final Summary.

The Detailed Project Report is projected to be completed this year and submitted to higher authority for approval. If nothing is done to deepen the lake and restore it's open water habitat, the lake will eventually be destroyed and fill completely in with sediment. The depth of the lake is only 10 feet at the outlet structure that was once 24 feet. The original storage capacity of 568 acre-feet is already reduced to 297 acre-feet. The surface area has been reduced by 12 acres. The team has set the goal of restoring the aquatic ecosystem of North Park Lake.

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Table 1.
North Park Lake – Pine Creek Dam
Pertinent Data

Name	North Park Lake
Owner	Allegheny County, Pennsylvania
Location	Pittsburgh, Pennsylvania
ID #	PA00467
Year completed	1935
Latitude	40° 35’ 54”
Longitude	79° 59’ 54”
Drainage Area	25 square miles
Normal Pool Elevation	960
Top of Dam Elevation	970
Area at Elevation 960	75 acres
Capacity at Elevation 960	568 acre feet
Total Spillway Capacity	10,500 cfs
Top of Dam Storage	1950 acre-feet
Dam	Pine Creek Dam
Tributary	Pine Creek
Height of Dam	33 feet
Outlet – Manual Operation	5’ x 5’ Reinforced Concrete Box
Upstream Invert Elevation	938.5
Downstream Invert Elevation	936
Outlet Length	570 feet
Crest Length	1130 feet

Table 2.
Sedimentation Analysis Summary

	Surface Area (acres)	Capacity (acre-feet)
1935 (Original)	75	568
2001	63	297
Storage Loss		271 acre-feet
Storage Loss per Year		4 acre-feet/year (5200 tons/year)

	Percentage of Storage Loss
1935	0
1979	33%
2001	48%

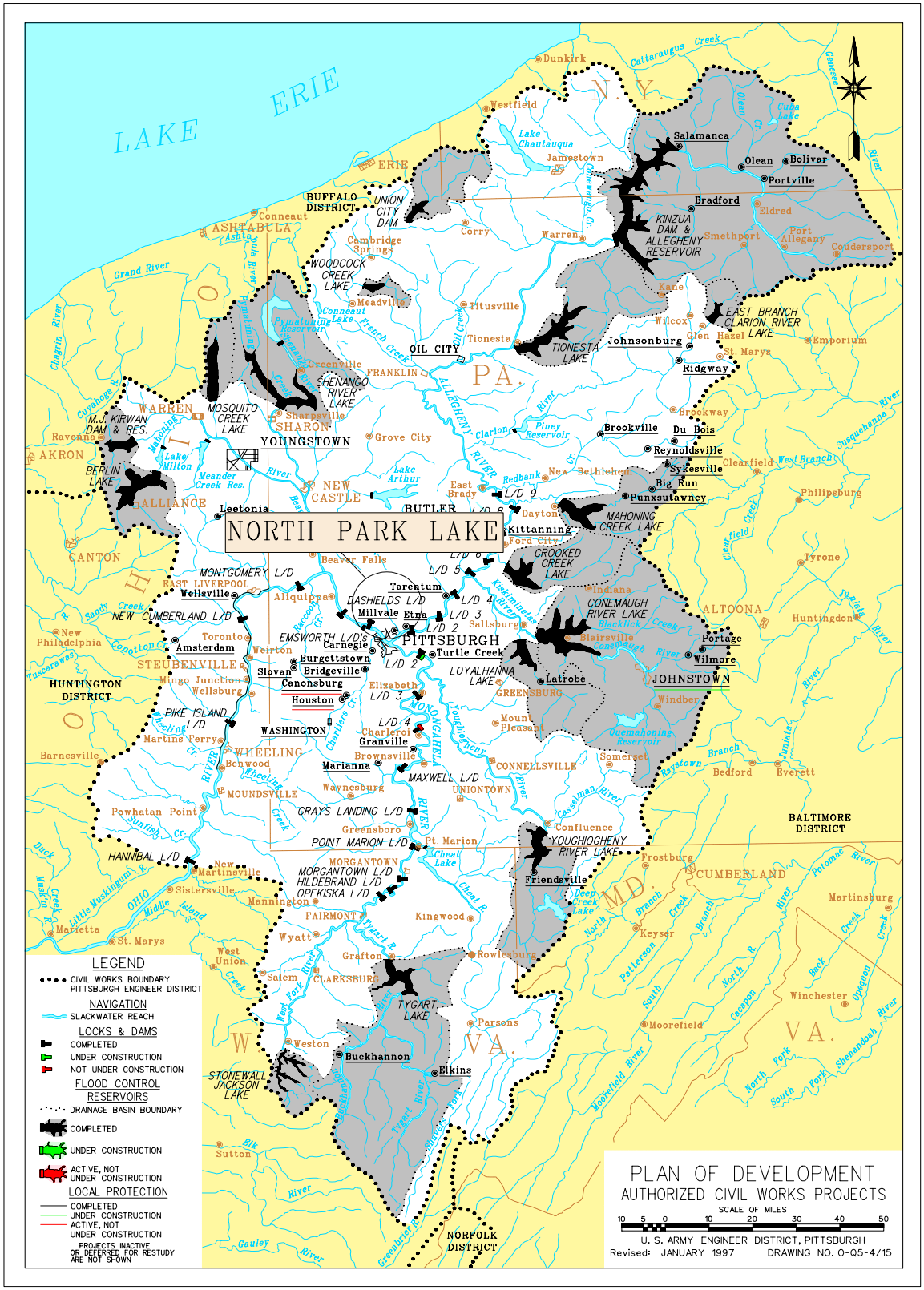

Figure 1. Location map

Figure 2. North Park Lake

Figure 3. Pine Creek Dam